

What is claimed is:

*SLB AL*

1. A combinatorial screening apparatus comprising:

- a cell body containing a fluid inlet;
- a fluid permeable, conductive, catalyst array support positioned adjacent to the cell body, said catalyst array support having multiple locations for supporting solids;
- a catalyst mask positioned adjacent to the catalyst array support, said catalyst mask having material removed to form holes where the holes are in alignment with the multiple locations for supporting solids of the catalyst array support; and
- a cell cover positioned adjacent to the catalyst array support, said cell cover having material removed to allow for monitoring of the solids.

2. The apparatus of Claim 1 further comprising a detector in alignment with the cell cover.

3. The apparatus of Claim 1 further comprising a gas diffuser positioned between the catalyst array support and fluid inlet of the cell body.

4. The apparatus of Claim 1 further comprising an excitation source in alignment with the cell cover.

5. The apparatus of Claim 4 wherein the excitation source is an ultraviolet radiation source.

6. The apparatus of Claim 1 further comprising at least one fastener.

7. The apparatus of Claim 1 further comprising a seal between each of the elements a-d of Claim 1.

8. The apparatus of Claim 1 further comprising a reagent mask located between the cell body and the catalyst array support.

9. The apparatus of Claim 1 further comprising a diffuser located between the cell body and the catalyst array support

10. The apparatus of Claim 1 wherein the catalyst array support is carbon paper.

*SLB AL*

11. The apparatus of Claim 1 wherein the catalyst mask is Plexiglas.

12. The apparatus of Claim 1 wherein the cell body is further characterized in having a fluid outlet.

13. A combinatorial screening apparatus comprising:  
a) a catalyst array support backing;  
b) a conductive catalyst array support positioned adjacent to the support backing, said catalyst array support having multiple locations for supporting solids;  
c) a catalyst mask positioned adjacent to the catalyst array support, said catalyst mask having material removed to form holes where the holes are in alignment with the multiple locations for supporting solids of the catalyst array support; and  
d) a cell cover positioned adjacent to the catalyst array support, said cell cover having material removed to allow monitoring of the solids.

14. The apparatus of Claim 13 further comprising a detector in alignment with the cell cover.

15. The apparatus of Claim 13 further comprising an excitation source in alignment with the cell cover.

16. The apparatus of Claim 13 further comprising a seal between each of the elements a-d of Claim 13.

17. A method for screening an array of solids for electrocatalytic activity comprising:  
a) depositing the solids of the array on a catalyst array support;  
b) placing a catalyst mask over the catalyst array support, said mask having material removed to form holes where the holes are in the same pattern as the solids of the array;  
c) contacting the array of solids on the catalyst array support masked by the catalyst mask with a reagent fluid and a fluid containing an ion concentration indicator;

*[Handwritten signature]*

- d) applying a potential to the catalyst array support;
- e) applying excitation radiation to said catalyst array support;
- f) measuring emission radiation emitting through the holes of the catalyst mask; and
- 5 g) determining electrocatalytic activity of the solids in the array from the emission radiation measurements.
- 18. The method of Claim 17 wherein the ion concentration indicator is a fluorescent pH indicator.
- 19. The method of Claim 18 wherein the ion concentration indicator is selected from the group consisting of Phloxine and Ni<sup>+</sup> 3-pyridin-2-yl-<4,5,6>-triazolo-<1,5-a>-pyridine.
- 10 20. The method of Claim 17 wherein the reagent fluid is a gas selected from the group consisting of oxygen and reformate gas.
- 21. The method of Claim 17 further comprising flowing the reagent fluid through a diffuser prior to contact with the array of solids.
- 15 22. The method of Claim 17 wherein the reagent fluid and the fluid containing an ion concentration indicator are identical.
- 23. The method of Claim 17 further comprising:
  - a) identifying one or more solids with high electrocatalytic activity;
  - 20 b) depositing an identified catalyst on a first side of a bulk catalyst support structure;
  - c) placing the bulk catalyst support structure on a bulk cell base with a second side of the bulk catalyst support structure adjacent to and in alignment with a fluid inlet and a fluid outlet of the bulk cell body;
  - 25 d) covering the identified catalyst with an electrolyte solution;
  - e) contacting the identified catalyst on the bulk catalyst support structure with a second reagent fluid that is passed through the fluid inlet adjacent the bulk catalyst support structure and through the bulk catalyst support structure;

5 f) applying a series of different voltages to the bulk catalyst support structure;

g) measuring the current generated during the application of each voltage; and

h) determining the electrocatalytic activity of the identified catalyst using the voltages and the current measurements.

24. 25. The method of Claim 23 further comprising repeating steps (b) through (h) of Claim 23 using additional identified catalysts.

25. A bulk catalyst testing apparatus comprising:

a) a bulk cell body containing a first and a second fluid inlet and a first and a second fluid outlet;

b) a fluid permeable bulk catalyst support structure having a catalyst thereon positioned adjacent to the bulk cell body and in alignment with the first fluid inlet and the first fluid outlet of the bulk cell body; and

c) a bulk cell cover positioned adjacent to the bulk catalyst support structure, said bulk cell cover having material removed to allow for fluid contact with the catalyst and monitoring of the catalyst.

26. The apparatus of Claim 25 further comprising a diffuser positioned between the bulk cell body and the bulk catalyst support structure.

27. The apparatus of Claim 26 wherein the diffuser is cloth.

28. The apparatus of Claim 25 wherein the bulk cell cover is further characterized by a protrusion extending outwardly to form a volume in alignment with the bulk catalyst support structure.

29. The apparatus of Claim 25 further comprising at least one fastener associated with the bulk cell body and the bulk cell cover.

30. The apparatus of Claim 25 further comprising a seal positioned between the bulk catalyst support structure and the bulk cell cover.

31. A method for screening a catalyst for electrocatalytic activity comprising:

5

- a) depositing the catalyst on a first side of a bulk catalyst support structure;
- b) placing the bulk catalyst support structure on a bulk cell base with a second side of the catalyst support structure adjacent to and in alignment with a fluid inlet and a fluid outlet of the bulk cell body;
- c) covering the catalyst with an electrolyte solution;
- d) contacting the catalyst on the bulk catalyst support structure with a reagent fluid that is passed through the fluid inlet adjacent the bulk catalyst support structure and through the bulk catalyst support structure;
- 10 e) applying a series of different voltages to the bulk catalyst support structure;
- f) measuring the current generated during the application of each voltage; and
- 15 g) determining the electrocatalytic activity of the catalyst using the voltages and the current measurements.

32. The process of Claim 31 wherein the reagent fluid is a gas selected from the group consisting of hydrogen, oxygen, and reformate gas.